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U1S S1714 S1720 S1931 S1932

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None

(58) Field of Search
UK CL (Edition M) **G4H HRE**
INT CL^5 **G08C**

(54) Transmitter control

(57) A trainable remote-control transmitter includes an attenuator for adjusting the level of an output signal as a function of the pulse width and frequency of the output signal. The transmitter also includes receiver components which are disabled when the transmitter is transmitting.

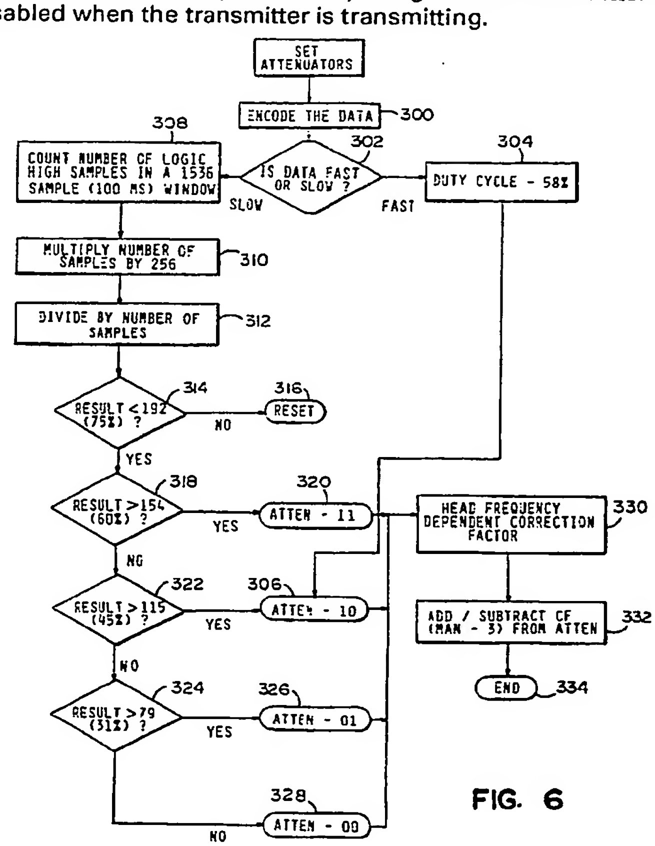

FIG. 6

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GB 2 277 620 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

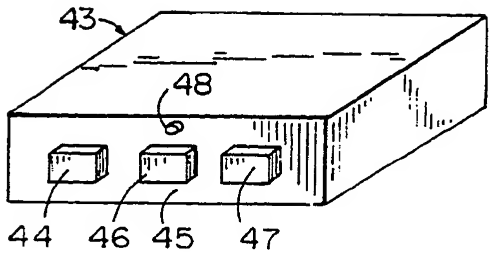

FIG. 1

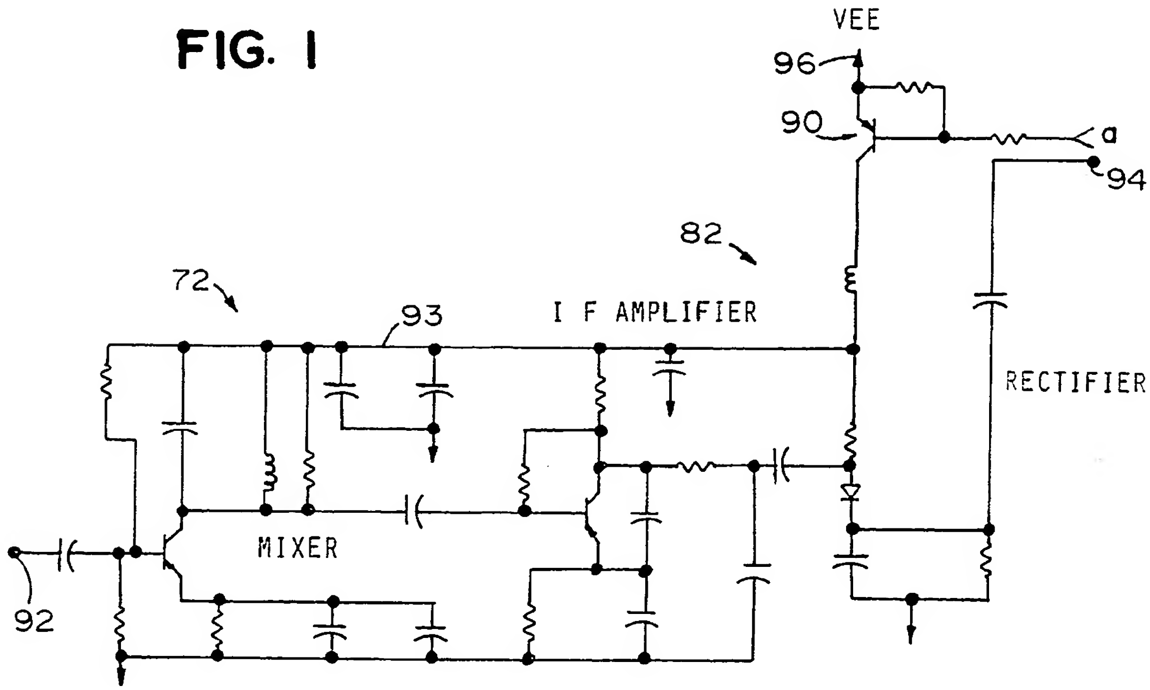

FIG. 4

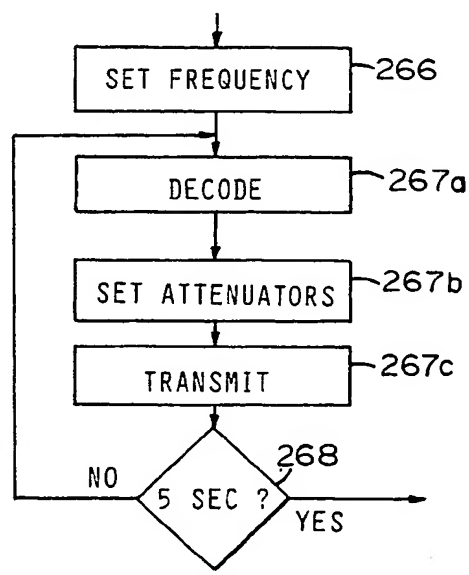

FIG. 5

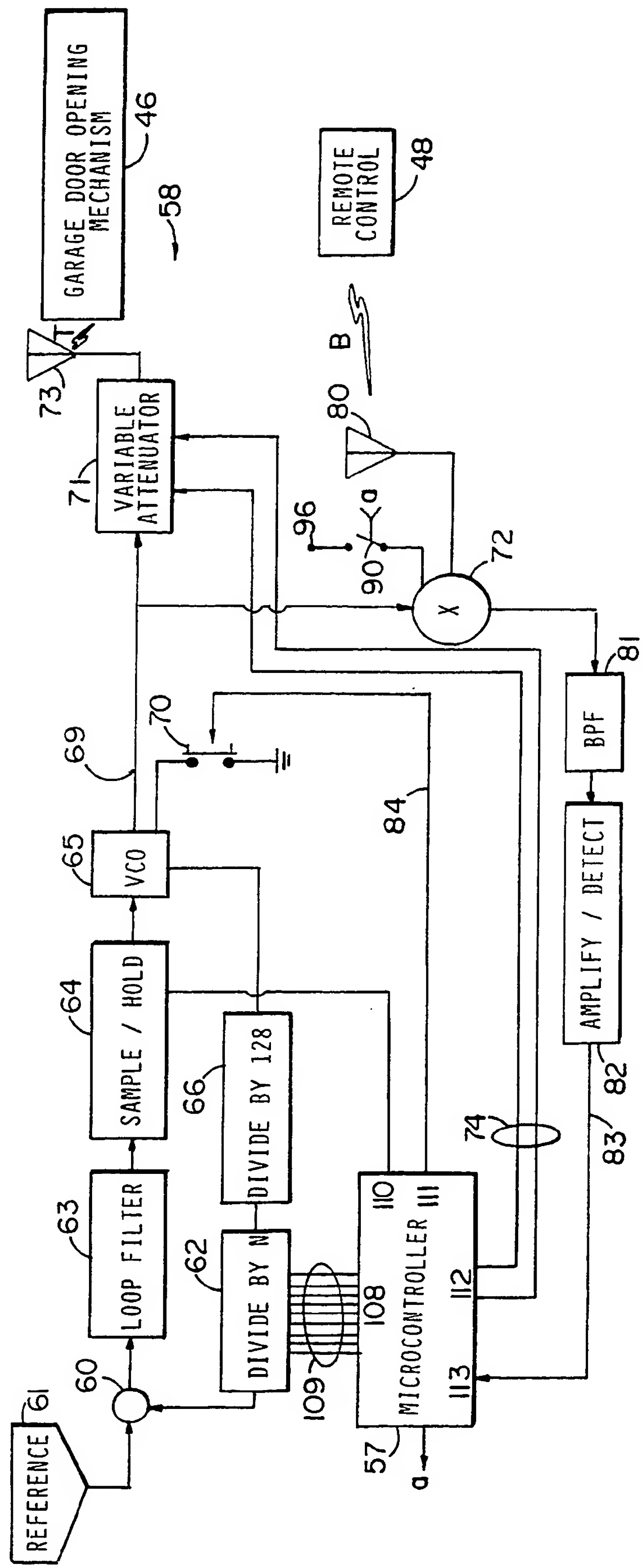
GARAGE DOOR OPENING MECHANISM
46
58
REMOTE CONTROL
48
B
73
VARIABLE ATTENUATOR
71
80
96
a
90
72
X
69
70
65
VCO
64
SAMPLE / HOLD
63
LOOP FILTER
66
DIVIDE BY 128
62
DIVIDE BY N
61
REFERENCE
60
109
108
MICROCONTROLLER
110
111
112
113
57
a
74
84
81
BPF
AMPLIFY / DETECT
82
83

FIG. 3

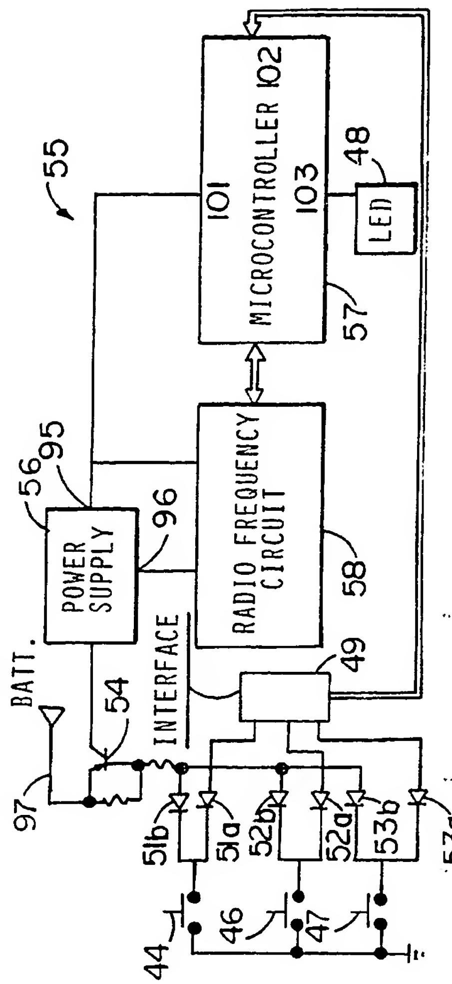
55
MICROCONTROLLER
101
102
103
57
48
LED
56
95
POWER SUPPLY
96
RADIO FREQUENCY CIRCUIT
58
BATT.
INTERFACE
49
54
97
51b
51a
52b
52a
53b
53a
44
46
47

FIG. 2

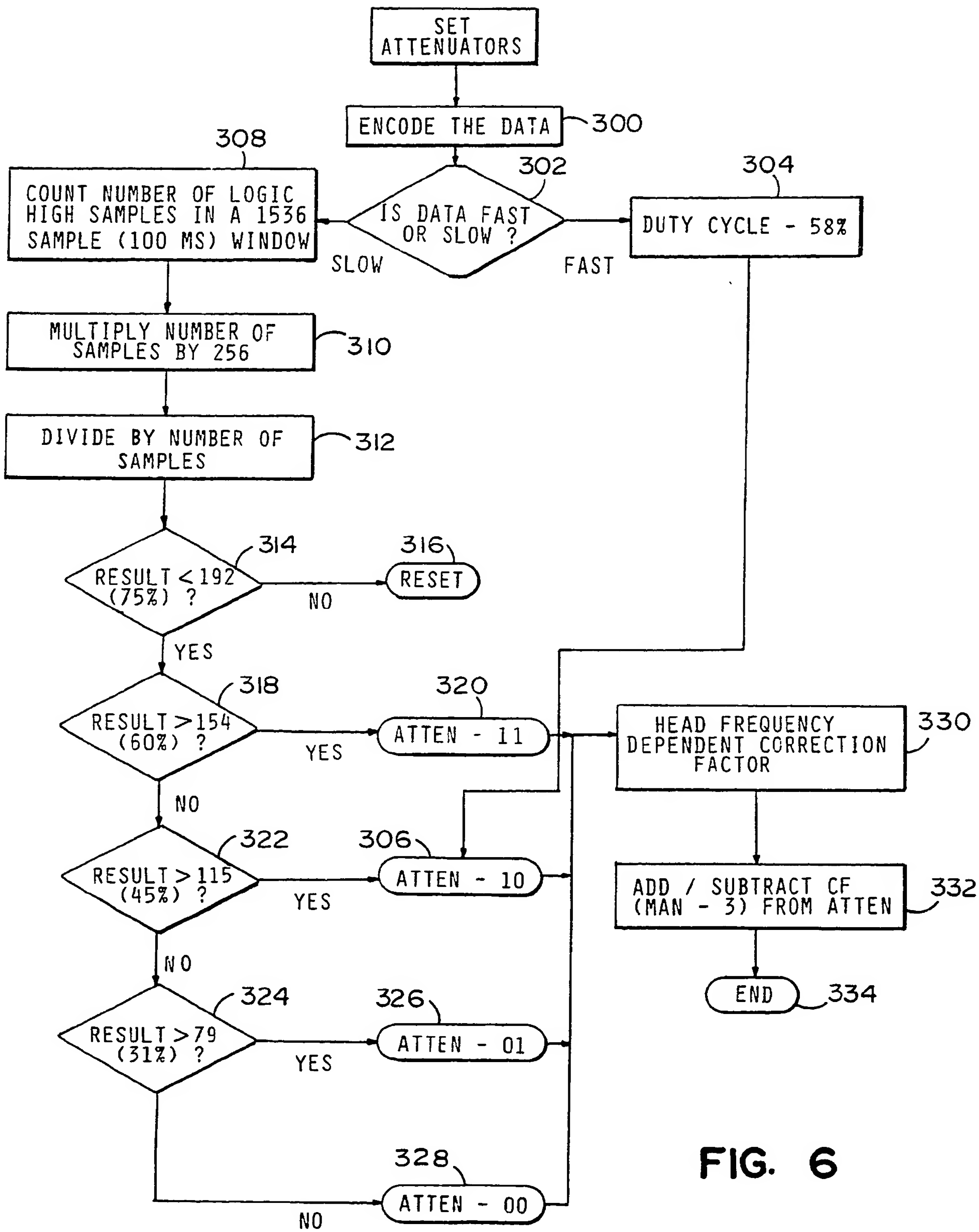
SET ATTENUATORS
ENCODE THE DATA
300
IS DATA FAST OR SLOW ?
302
SLOW
FAST
DUTY CYCLE - 58%
304
COUNT NUMBER OF LOGIC HIGH SAMPLES IN A 1536 SAMPLE (100 MS) WINDOW
308
MULTIPLY NUMBER OF SAMPLES BY 256
310
DIVIDE BY NUMBER OF SAMPLES
312
RESULT < 192 (75%) ?
314
NO
RESET
316
YES
RESULT > 154 (60%) ?
318
YES
ATTEN - 11
320
NO
RESULT > 115 (45%) ?
322
YES
ATTEN - 10
306
NO
RESULT > 79 (31%) ?
324
YES
ATTEN - 01
326
NO
ATTEN - 00
328
HEAD FREQUENCY DEPENDENT CORRECTION FACTOR
330
ADD / SUBTRACT CF (MAN - 3) FROM ATTEN
332
END
334

FIG. 6

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TRANSMITTER CONTROL

BACKGROUND OF THE INVENTION

This application pertains to radio frequency transmitters and more particularly to a trainable radio frequency transceiver for remotely controlling one or more devices.

A trainable transceiver includes receiver components for inputting the control signals in a training mode, this can introduce noise into the output signal in the subsequent transmission mode. An additional difficulty is providing a gain control for adjusting the output level of the transmitter such that it complies with the radiation requirements over the entire frequency range of the transmitter and effectively compensates for inherent variations in the signal strength of the transmitter at different frequencies.

SUMMARY OF THE INVENTION

The system of the present invention provides an improved radio frequency transmitter. According to one aspect of the invention, the transmitter includes an output signal generator which outputs a transmission signal. The amplitude of the transmission signal is controlled responsive to an amplitude control signal. According to another aspect of the invention, the amplitude is controlled as a function of the frequency and pulse duration of the transmission signal.

According to another aspect of the invention, the transmitter is of a trainable type including a receiver which inputs a radio frequency control signal in a training mode. The receiver is disabled when the transmitter is transmitting an output signal.

The transmitter according to the invention provides improved transceiver operation as the signals emitted from

the transceiver have a high signal-to-noise ratio. Additionally, the output signal amplitude of the transmitter is adjusted to compensate for variations in the strength of signals output by the transmitter at different frequencies.

These and other features, objects and advantages of the present invention can best be understood by reading the following description thereof together with reference to the accompany drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a housing for the trainable transmitter according to the present invention;

Fig. 2 is an electrical circuit diagram partly in block and schematic form of a transceiver embodying the present invention;

Fig. 3 is an electrical circuit diagram partly in block diagram form of a transceiver embodying the present invention;

Fig. 4 is a circuit schematic of a mixer for the circuit according to Fig. 3;

Fig. 5 is a partial flow diagram of a main program employed in the microcontroller of the programmable control circuit shown in Figs. 2-3; and

Fig. 6 is a flow diagram for a program subroutine for setting the attenuation level.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring initially to Figure 1, the invention is integrated into a small, generally square module housing 43 including a transceiver 55 (Fig. 2) which selectively transmits coded radio frequency (RF) energy as indicated by arrow "T" to a device controlled by an RF control signal, such as a garage door opening mechanism 46 shown in block form in Figure 3. The conventional garage door opening

mechanism 46 includes a receiver and a control circuit (not shown) which respond to the control signal "T" for opening and closing a garage door. Transceiver 55 includes a programmable microcontroller 57 which controls a radio frequency (RF) circuit 58 to generate signal "T". Signal "T" has a frequency and code learned from signal "B" and transmitted by existing remote control transmitter 48 while transceiver 55 is in a training mode. The transceiver can then transmit the stored signal as remote control signal "T" to activate garage door opening control mechanism 46 (Fig. 3) without further need for the remote transmitter 48. Transmitter 48 is typically provided with the garage door opening mechanism 46 and generates control signal "B" for remotely actuating the garage door opening mechanism.

Somewhat more particularly, housing 43 is small such that it may be installed in a variety of locations in the vehicle, such as in an overhead counsel, a map light, the instrument panel or any other suitable position in the vehicle. The transmitter includes three switches 44, 46 and 47 in a front panel 45. Each switch is associated with a respective channel. A channel includes one control signal for remotely actuating one mechanism. For example, the three channels may have three signals associated with three, respective, garage door opening mechanisms. Alternatively, two of the channels can have signals for two, respective, garage door openers, and the third channel can have a signal for controlling an interior light, exterior lights, or the like.

Still more particularly, each of switches 45, 46 and 47 is used to train and actuate its respective channel. For example, when one of these switches is held for less than a predetermined time period (e.g., less than 20 seconds),

transmitter 55 will transmit the signal stored for that channel. If the switch is held for longer than the predetermined time period, the microcontroller will enter the training mode for the channel associated with that held switch.

An LED 48 is provided on panel 45 to inform the operator of the operational mode. For example, the LED is illuminated continuously while the signal is being transmitted. When the transmitter is in the learning mode, the LED flashes. When the training mode is finished, the LED flashes at a rate five times faster than the learning mode rate.

Although the overall preferred mounting environment is described with respect to the generally square housing, the transmitter according to the invention may be used in other environments. For example, the improved transmitter of the immediate invention may be used in a mirror, an overhead console, a map light or the like.

Having briefly described the overall preferred mounting environment and operation of the transmitter, and its relationship to a vehicle, a detailed description of the preferred embodiment is now presented in connection first with the circuit diagram of Figs. 2 through 4, and subsequently with reference to the program flow diagrams of Figs. 5 and 6. Referring to Figure 2, RF transceiver circuit 55 is mounted within module housing 43. Switches 44 (Fig. 4), 46 and 47 are connected through respective diodes 51a, 52a and 53a and a conventional interface 49 to microcontroller 57. Microcontroller 57 includes three inputs 102, each of which is connected to a respective one of switches 44, 46 and 47. The microcontroller inputs are pulled to ground when its respective switch is closed.

Switches 44, 46 and 47 are also connected through diodes 51b, 52b and 53b to a switch 54. Switch 54 is connected between the vehicle battery supply and power supply 56 such that it is closed when any one of switches 44, 46 and 47 is closed.

Power supply 56 converts operating power from the vehicle battery supply to the necessary voltage levels in a conventional manner for activation of the electrical circuits when switch 54 is closed. Circuit 55 includes microcontroller 57 coupled to an RF circuit 58. Circuit 55 also includes indicator LED 48, which is illuminated when one of switches 44, 46 and 47 is closed and flashes when the circuit enters the training mode for one of the switches.

As seen in Figure 3, RF circuit 58 includes a summing circuit 60 which sums a signal output from reference signal generator 61 and a signal output from a divide-by-N-divider 62. Reference generator 61 generates a fixed frequency signal, and may be provided by a commercially available crystal oscillator with an output frequency of approximately 8 Mhz and a divider which reduces the reference frequency signal to 7.8125 Khz. Divider 62 is provided by any suitable commercially available divider, such as an integrated circuit model number 145151 or 145106. The output signal from the summing circuit is coupled to the input of the loop filter 63, which is preferably an active integrator including an operational amplifier and a capacitor. The output of the integrator is a DC signal which is applied to the input of a sample-and-hold circuit 64. Sample-and-hold circuit 64 is of any suitable, conventional construction, such as a switch and a capacitor (not shown) or an amplifier with associated circuit components. In either case, the sample-and-hold circuit is

controlled by a control signal from output 110 of microcontroller 52. The output of sample-and-hold circuit 64 is applied as a control input signal to a voltage controlled oscillator (VCO) 65.

The output frequency of VCO 65 will increase or decrease according to the magnitude of the control input voltage from sample-and-hold circuit 64. The voltage controlled oscillator may be provided by any suitable voltage controlled oscillator which is tunable to frequencies between 200 and 400 Mhz with an input tuning control voltage of 0-7 volts, and adapted to operate in the automobile environment. In a preferred embodiment of the invention, VCO 65 is of a type including two varacter diodes, two transistors, capacitors, resistors and an inductor coupled to provide the desired frequency output for a given input voltage. A switch 70 is connected to VCO 65 such that the VCO generates an oscillating output signal only when switch 70 is open. When switch 70 is closed, the VCO is disabled by connecting an internal junction to ground. Switch 70 may be of any suitable construction, such as a bipolar transistor, an FET, a relay switch, or the like. Sample-and-hold circuit 64 holds the control input voltage to VCO 65 at a set level when the VCO stops generating an oscillating output signal, such that the VCO will output a signal having the desired frequency when the VCO is switched from off to on.

The output of VCO 65 is input to a divide-by-128 divider 66, a variable attenuator 71 and a mixer 72. Variable attenuator 71 includes two series circuits, each of which has an impedance element and a switch connected between a node of a divider network and ground for controlling the magnitude of the output signal of VCO 65,

such that the amplitude of the signal output from VCO 65 is adjusted. In one implementation of the invention, variable attenuator 71 includes two resistors connected in parallel between antenna 73 and ground. Each resistor is connected in series with a bipolar transistor. The switch may also be implemented by an FET or the like. In operation, one of the transistors, both of the transistors, or neither transistor is activated to shunt the output voltage of VCO 65 through its respective resistor depending upon the amplitude control signal which is generated in microcontroller 57 as described in greater detail hereinbelow.

Mixer 72 combines the signal output from VCO 65 with signal "B" from remote control 48, which is received by antenna 80. The output signal from mixer 72 is applied to filter 81, and will have a frequency of 3 Mhz when the output of VCO 65 is 3 Mhz greater than the frequency of the signal for remote control 48. A conventional bandpass filter 81 has a center frequency of 3 Mhz to pass the detected signal output from mixer 72, which is applied to the input of the amplifier/detector 82. Amplifier/detector 82 includes a half-wave rectifier, provided by a series diode (not shown), and an amplifier. The output of amplifier/detector 82 is a digital signal applied to input 113 of microcontroller 57.

A switch 90 (Figs. 3 and 4) is connected between the power supply output 96 and mixer 72. In one implementation of the invention, mixer 72 (Fig. 4) includes an input 92 connected to antennae 80 and VCO 65. Mixer 72 includes a transistor and associated capacitors, resistors and an inductor, which are connected to an amplifier and rectifier. The amplifier includes a transistor and associated resistors and capacitors. Switch 90 is connected between the supply

rail 93 for mixer 72 and amplifier 82 and the power supply 96. Switch 90 is connected to microcontroller 57 in a conventional manner, and is responsive to an output signal from the microcontroller to disable the mixer and amplifier. More specifically, the switch is closed when the transmitter is emitting a signal and the switch is open when a signal is received in a training mode. Although the switch is illustrated as an NPN bipolar transistor, it may be provided by any suitable means such as an FET device having a control input connected to microcontroller 57, a relay switch, or the like.

Microcontroller 57 controls the operation of circuit 55 and may be provided by any suitable commercially available integrated circuit, such as IC Model No. MC68HC05P4 commercially available from Motorola. The microcontroller preferably includes a nonvolatile memory in which the microcontroller program is stored. The power supply 56 (Fig. 4) provides a regulated 5 volt DC reference potential at terminal 95 and a regulated 12 volt DC reference potential at terminal 96. Circuits for providing the regulated voltage are well-known and, accordingly, will not be described in further detail herein. Power supply 56 receives power from the vehicle battery through switch 54 and battery positive conductor 97. The microcontroller 57 includes a power supply input 101 connected to the 5 volt power supply output 95 to receive power therefrom. Accordingly, when one of switches 44, 46 and 47 is closed, closing switch 54, power is supplied to RF circuit 58 and microprocessor 57. When switch 54 is open (switches 44, 46 and 47 are open), the microcontroller and radio frequency circuit are disabled since the power supply is disabled. Terminals 102 of microcontroller 57 are connected to the

three switches 44, 46 and 47 by respective diodes as indicated above. Output terminal 103 is connected to LED 48 to energize the LED.

The RF circuit 58 connected to microcontroller 57 includes all of the circuit elements shown in Fig. 5, except for microcontroller 57, garage door opener mechanism 46, and the existing remote control 48. Outputs 108 of microcontroller 57 are connected to divide-by-N divider 62 through multiconductor bus 104. Bus 104 is connected to the control input of divide-by-N divider 62 to select the frequency of the signal output by divide-by-N divider 62. Output 110 of microcontroller 57 is connected to control the sample-and-hold circuit 64 to hold the signal level input to the VCO when switch 70 is closed such that VCO 65 does not output oscillating signals. Output 111 of microcontroller 67 is connected to the control input of switch 70. Outputs 112 of microcontroller 57 are connected to variable attenuator 71 to select the degree of attenuation to be provided to the signal output from VCO 65. Signals received by antenna 80 are connected to data input 113 of microcontroller 57 through mixer 72, bandpass filter 81 and amplifier detector 82.

The circuit represented by Figs. 2 through 4 is a self-contained trainable transmitter for the environment illustrated in Fig. 1. It will be recognized that microcontroller 57 will include additional inputs and outputs for alternate environments.

In the training mode, the program trains to data in the control signal "B" in an encode subroutine. After the encode subroutine is completed, the set attenuators subroutine of Fig. 6 is called. The set attenuator subroutine will now be described with reference to Fig. 6.

Initially, the encoded data is retrieved from memory as indicated in block 300. The program determines from the encoded data whether it is fast or slow data, as indicated in decision block 302. This decision is made by determining whether the signal to be transmitted is mode 1 data or mode 0 data. Briefly, Mode 1 data is data that switches between two frequencies (e.g., GENIE brand garage door openers which switch between 10 KHz and 20 KHz). The duty cycle for these signals is 50% as indicated in block 304, and the attenuation is set to 10, meaning one attenuator is on and the other attenuator is off, as indicated in block 306. If the decision in block 302 is the data is slow data, meaning the data is mode 0 data, (e.g., garage door openers other than GENIE brand garage door openers) the program counts the number of logic high samples in a 100 msec. time window as indicated in block 308. The number of samples should be 1536, although the actual number might vary slightly. The number of high samples counted in block 308 is multiplied by 256 in block 310. The result determined in block 310 is divided by the total number of samples (e.g., 1536) as indicated in block 312.

Following the calculations of blocks 308, 310, and 312, the program sets the attenuators according to the duty cycle of the data. If the result of the decision in block 312 is greater than or equal to 192, as determined in decision block 314, there is an error in the encoding, and the program resets and retrains as indicated in block 316. If the result of decision block 312 is less than 192, indicating the high logic level duration is less than 75%, the program determines whether the result is less than 154, which corresponds to a high level signal less than 68%, as determined in block 318. If it is determined in block 318

that the high logic level duration is more than 68%, the attenuation is set to 11, which means both attenuators are on. If the high logic level duration is less than or equal to 68%, the program determines whether the result is greater than 115, which corresponds to a high logic level duration of less than 45%, in decision block 322. If it is determined in block 322 that the high logic level duration is more than 45%, the attenuation is set to 10 (first attenuator on, second off), as indicated in block 306. If it is determined that the high logic level is duration is less than or equal to 45%, the program determines whether the result is less than 79 in decision block 324. If the decision in block 324 is the result is greater than 79, the program sets the attenuation to 01, wherein the second attenuator is on and the first one is off. If the high logic level duration is less than 31%, the attenuation is set to 00, wherein both attenuators are off.

After the attenuators are set according to the pulse duration, the set attenuation is adjusted using a frequency dependent correction factor as indicated in block 330. The frequency dependent correction factor is dependent upon the frequency of the control signal. Preferably, a table is provided which indicates the relative strength of the transmitter at different frequencies. For example, the strength of signals output from the transmitter circuit of Fig. 3 may be measured at fixed intervals (e.g. every 1 Khz or every 10 Khz) and this information may be stored in the memory table. Alternatively, the strength of the transmitter may be measured at each of the frequencies at which garage door openers are known to operate. In either case, the correction factor is preferably dependent upon the acceptable amplitude limits on signal strength at each of

the different frequencies. Thus, the attenuation factor is adjusted for variations in the strength of the signal emitted by the transmitter at each of the frequencies, and signal strength is decreased at those frequencies where the acceptable radiation requirements limit the amplitude to a level below that produced by the transmitter. The correction factor has a binary value between 0 and three (i.e., 01, 10, 11) which is added to, or subtracted from, the attenuation values set in blocks 320, 306, 326 and 328. After the attenuation value is stored, the program returns to the main program as indicated in block 334.

That portion of the program which calls the set attenuation subroutine of Fig. 6 and disables mixer 72 is shown in Fig. 5. Before transmitting a signal, the frequency is set in block 265 (Fig. 5), and the program downloads the data word stored in the nonvolatile memory in block 267a. The program sets the attenuators using the attenuation levels set by the set attenuators subroutine of Fig. 6, in block 267b, which is described in greater detail hereinbelow. The program will then transmit the code signal and disable mixer 72, as indicated in block 267c, for a period of up to twenty seconds. After five seconds, the program enters the training mode, as indicated by decision block 268, wherein the mixer is enabled.

It is envisioned that the set attenuators subroutine can be run each time that the program learns a frequency and control word in the training mode. The subroutine will be run for each channel independently. It is also envisioned that the subroutine could be run each time the transmitter is transmitting. In either case, the attenuators are set to the level determined in the set

attenuators subroutine during transmission of the signal as indicated in Fig. 5.

Thus it can be seen that a transmitter is disclosed providing improved signal quality and amplitude control. The transmitter controls the attenuation according to the signal strength of signals output by the transmitter at different frequencies. Additionally, the attenuation can be controlled at different frequencies. For a trainable transmitter of the type transmitting and receiving signals, the circuit components for receiving a signal are disabled when transmitting a signal to reduce interference from the receiving circuit components.

It will become apparent to those skilled in the art that various modifications to the preferred embodiment described and disclosed herein can be made. Such modifications will, however, fall within the spirit or scope of the invention as defined in the appended claims.

CLAIMS

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

-1-

A trainable transmitter for learning and selectively transmitting at least one of a plurality of different radio frequency signals to remotely actuate a device, comprising:

a controller;

an input signal generator having a first input, a second input, and an output, said first input coupled to receive a control signal from a remote device, said second input connected to the controller for receiving a disabling signal from said controller response to which said input signal generator is selectively disabled, and an output signal being output from said signal generator at said output when said input signal generator is enabled;

an output signal generator having a third input and a second output, said third input connected to said controller for receipt of a control signal and said signal generator responsive to said output signal generator control signal for generating an output signal supplied to said output signal generator output; and

an amplitude controller having an input coupled to said output signal generator and a control input coupled to receive an amplitude control signal from said controller, said amplitude controller responsive to said amplitude control signal for selectively controlling the amplitude of said output signal from said output signal generator.

-2-

The transmitter as defined in claim 1, wherein said input signal generator includes a fifth input, said

fifth input connected to said output of said signal generator, said output signal generator combining said output signal of said output signal generator with said control signal from said remote device and outputting said combined signal at said first output.

-3-

The transmitter as defined in claim 2, wherein said mixer is selectively connected to a power supply through a switch, said switch connected to said second input such that said mixer is disconnected from the power supply when the input signal generator is disabled.

-4-

The transmitter as defined in claim 3, further including a detector connected to the output of said mixer, said detector outputting control signals when the output of said output signal generator and said control signal are spaced by approximately a predetermined amount.

-5-

The transmitter as defined in claim 1, wherein said controller outputs an amplitude control signal as a function of the carrier frequency of the output signal of the output signal generator.

-6-

The transmitter as defined in claim 5, wherein said amplitude control signal is also a function of the pulse duration of the control signal.

-7-

The transmitter as defined in claim 1, wherein said controller outputs an amplitude control signal as a function of the pulse duration of the control signal.

-8-

A transmitter for selectively transmitting one of a plurality of different radio frequency signals having different carrier frequencies and control signals to remotely actuate a plurality of devices, comprising:

a controller;

a signal generator having an input coupled to said controller for receiving a frequency control signal and an output at which radio frequency signals are output; and

an amplitude controller having an input coupled to said output of said signal generator and a control input coupled to receive an amplitude control signal, said amplitude controller responsive to said amplitude control signal for selectively, uniquely controlling the amplitude of said signal output by said output signal generator and emitted by the transmitter to control each of said devices.

-9-

The transmitter as defined in claim 9, wherein said amplitude controller includes at least one impedance element coupled to said output of said signal generator for selectively attenuating the output signal of said signal generator.

-10-

The transmitter as defined in claim 10, wherein said controller outputs an amplitude control signal which is a function of the carrier frequency of the output signal of said signal generator.

-11-

The transmitter as defined in claim 9, wherein said controller outputs an amplitude control signal which is also a function of the pulse duration of the actuation signal output by said signal generator.

-12-

The transmitter as defined in claim 8, wherein said controller outputs and amplitude signal is a function of the pulse duration of the control signal output by the amplitude control circuit.

-13-

A trainable transmitter for learning at least one of a plurality of different radio frequency signals for remotely actuating a device, comprising:

a controller;

a signal generator having a first control input, a reference signal input and an output, said first control input coupled to receive a remote control signal from a remote control for the device, a second input for receiving a disabling signal for selectively disabling said input signal generator, and an output at which said output control signal is supplied when said signal generator is enabled whereby said signal generator may be selectively disabled when a transmitter transmits signals.

-14-

The transmitter as defined in claim 13, wherein said signal generator includes a third input, said third input connected to said output of said signal generator, said output signal generator combining said output signal of said output signal generator with said control signal from said remote device and outputting said combined signal at said first output.

-15-

The transmitter as defined in claim 14, wherein said mixer is selectively connected to a power supply through a switch, and said switch is connected to said

second input such that said mixer is disconnected from the power supply when the input signal generator is disabled.

-16-

The transmitter as defined in claim 15, further including a detector connected to the output of said mixer, said detector outputting control signals when the output of said output signal generator and said control signal are spaced by approximately a predetermined amount.

-17-

A trainable transmitter for learning radio frequency control signals to selectively actuate at least one mechanism controlled by a radio frequency signal, comprising:

a controller receiving a signal in a training mode and generating attenuation control signals from the trained signal;

a signal generator having an input coupled to said controller for receiving a radio frequency control signal and an output at which an activation signal is supplied;

an attenuation controller for coupled to said generator for attenuating the activation signal dependent upon the attenuation control signal whereby the signal attenuation is set for each signal.

-18-

The transmitter as defined in claim 17, wherein said controller outputs an amplitude control signal as a function of the carrier frequency of the output signal of the output signal generator.

-19-

The transmitter as defined in claim 18, wherein said amplitude control signal is also a function of the pulse duration of the control signal.

The transmitter as defined in claim 19, wherein said controller outputs an amplitude control signal as a function of the pulse duration of the control signal.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report) -20-

Relevant Technical Fields (i) UK Cl (Ed.M) G4H (HRE) (ii) Int Cl (Ed.5) G08C **Databases** (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii)	Application number GB 9407525.6 Search Examiner M J DAVIS Date of completion of Search 23 MAY 1994 Documents considered relevant following a search in respect of Claims :- 1-7, 17-20

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&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages	Relevant to claim(s)
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